



HAL
open science

Assessing impacts of cropping systems on biodiversity: comparison of indicators for four systems along an intensity gradient

Christian Bockstaller

► To cite this version:

Christian Bockstaller. Assessing impacts of cropping systems on biodiversity: comparison of indicators for four systems along an intensity gradient. International Conference on Computational Statistics, Aug 2019, Montevideo, Uruguay. hal-02327587

HAL Id: hal-02327587

<https://hal.science/hal-02327587>

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



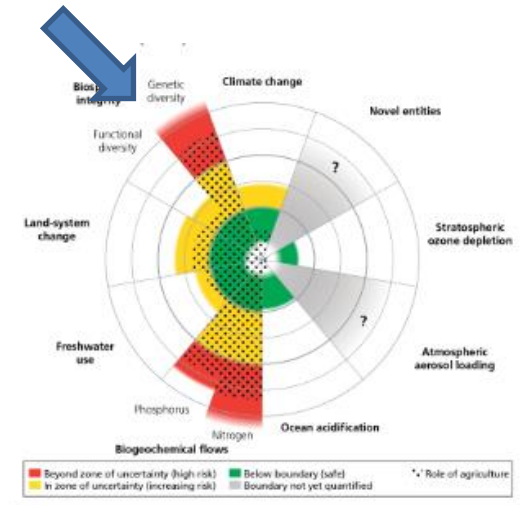
Assessing impacts of cropping systems on biodiversity: comparison of indicators for four systems along an intensity gradient

T. Denoirjean, V. Tossier, F. Angevin, C. Bockstaller



Introduction

- ❖ Biodiversity a major concern at planet level
- ❖ Every action supporting biodiversity
- ❖ e.g. design of innovative cropping systems
- ❖ needs assessment methods



(Campbell et al., 2017)



Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
Seventh session
Paris, 29 April-4 May 2019

Report of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on the work of its seventh session

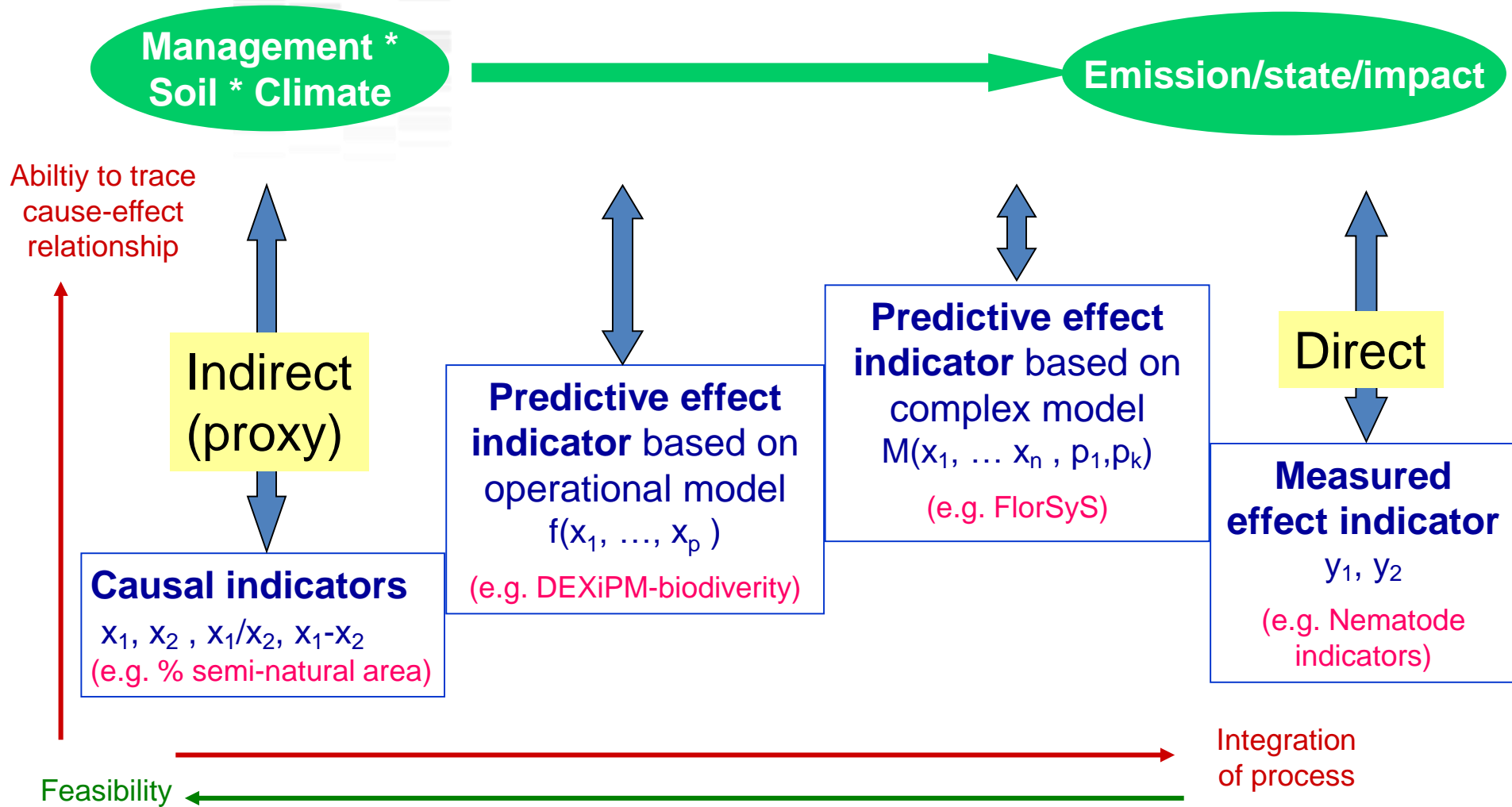
Addendum

Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

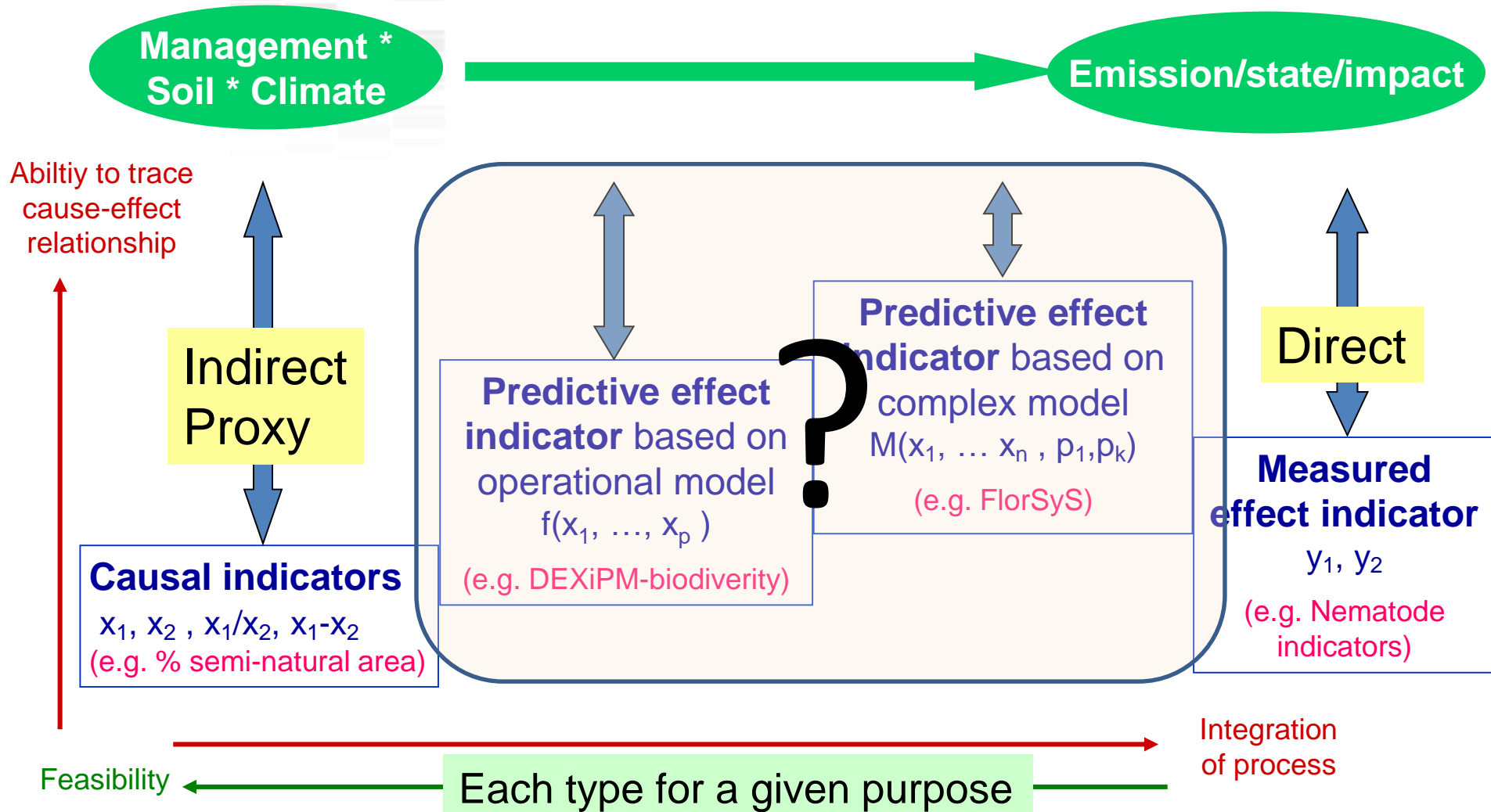
At its seventh session, in conjunction with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) approved the summary for policymakers of the global assessment of biodiversity and ecosystem services as set out in the annex to the present addendum.

(IPBES, 2019)

Different types of indicators *(Bockstaller et al. 2015 OCL)*



Different types of indicators *(Bockstaller et al. 2015 OCL)*

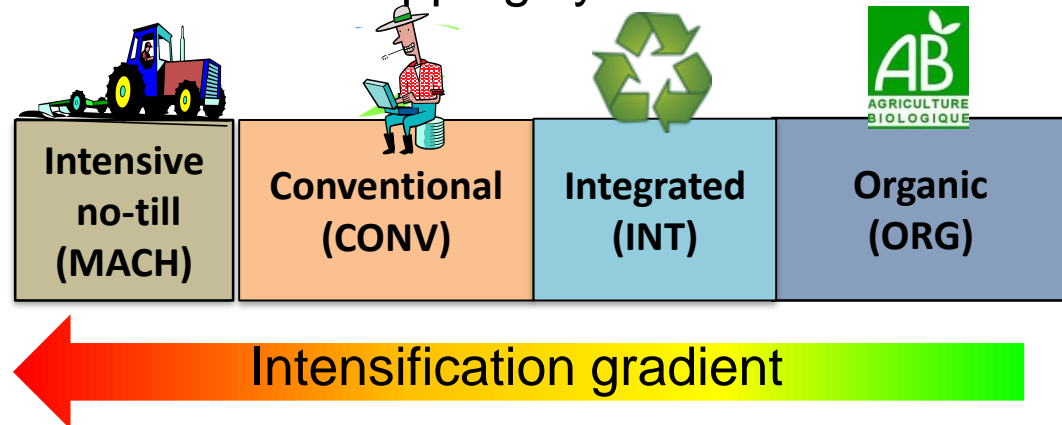
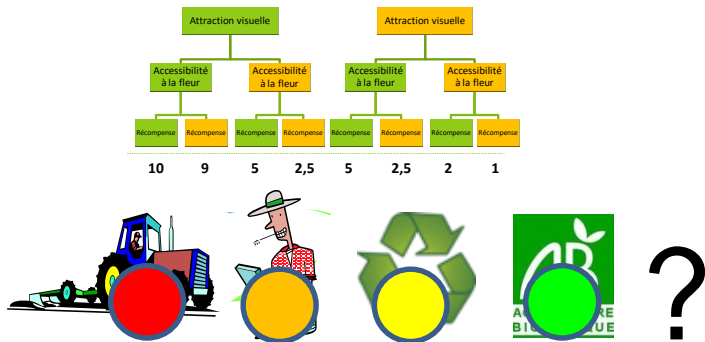


Aim of the presentation

- ❖ Any implementation of indicator
- ❖ Relevance of their outputs?
- ❖ Different approaches (Bockstaller *et al.*, 2008).
- ❖ Here comparison

Causal & predictive indicators

vs. 4 cropping systems



Material & methods: Indicators selected

- ❖ Review of biodiversity indicators in the French INDIC database (Thomas-Delille 2015) and of \approx 15 methods
- ❖ A set of indicators and 4 methods included in the study

Author	Method	Aggregation	Indicator type	Theme	Scale
Billeter <i>et al.</i> 2007	No	No	causal	Biodiversity	Landscape/field
Chabert 2015 ^a	Auximore	with DEXi	Predictive	Natural enemies	Field/crop. System (CS)
Craheix <i>et al.</i> 2012	MASC 2.0	with DEXi	Predictive	Biodiversity	Field/CS
Pelzer <i>et al.</i> 2012	DEXiPM V1	with DEXi	Predictive	Biodiversity	Field/CS
Demade 2014 ^b	DEXiPM V2	with DEXi	Predictive	Biodiversity	Field/CS

^a report, ^b master thesis

The DEXi tool (Bohanec et al. 2008 EM)

Definition of decision tree

- Durabilite Totale
 - Durabilite Economique
 - ▲ Rentabilite
 - Autonomie
 - ▲ Niveau d independance ec
 - ▲ Efficience economique
 - ▲ Besoins en materiel
 - Acceptabilite Sociale
 - ▲ Contribution a l emploi
 - Difficultes operationnelles
 - ▲ Penibilite du travail

Parametrization of input variables (e.g. classes)

Name: Durabilite Totale

Description: Appreciation qualitative de la durabilite agro-environnementale et socio-économique des systemes de culture innovants

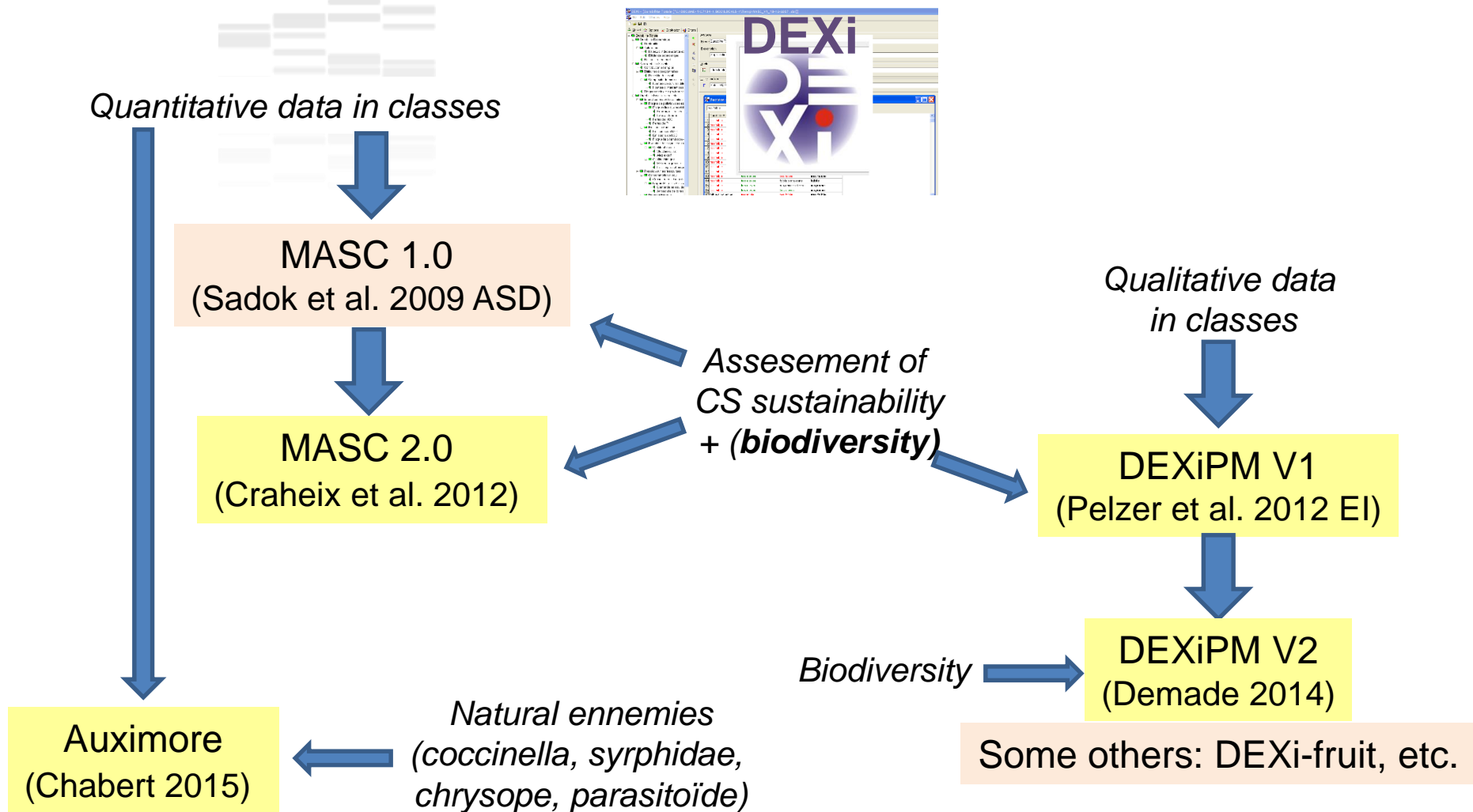
Scale: + tres faible(-); faible(-); moyenne; elevee(+); tres elevee(+)

Utility function: Rules: 64/64 (100,00%), determined: 100,00%

Elicitation of decision rules (if then): manually or automatically with weighting

	Durabilite Economique	Acceptabilite Sociale	Durabilite Environnementale	Durabilite Totale
1	tres faible	tres faible	tres faible	tres faible
2	tres faible	tres faible	faible a moyenne	tres faible
3	tres faible	tres faible	moyenne a elevee	tres faible
4	tres faible	tres faible	tres elevee	tres faible
5	tres faible	faible a moyenne	tres faible	tres faible
6	tres faible	faible a moyenne	faible a moyenne	faible
7	tres faible	faible a moyenne	moyenne a elevee	faible
8	tres faible	faible a moyenne	tres elevee	faible
9	tres faible	moyenne a elevee	tres faible	tres faible
10	tres faible	moyenne a elevee	faible a moyenne	faible
11	tres faible	moyenne a elevee	moyenne a elevee	faible
12	tres faible	moyenne a elevee	tres elevee	moyenne
13	tres faible	tres elevee	tres faible	tres faible
14	tres faible	tres elevee	faible a moyenne	faible
15	tres faible	tres elevee	moyenne a elevee	moyenne
16	tres faible	tres elevee	tres elevee	moyenne
17	faible a moyenne	tres faible	tres faible	tres faible

DEXi implementation in France (Bockstaller et al. 2018)



Cropping systems tested

- ❖ Système expérimental à Arvalis-Institut du Végétal station (South of Paris)
- ❖ 4 cropping systems : rotations \approx similaires (in ORG 2 alfafa ley)



**Intensive
no-till
(MACH)**



**Conventional
(CONV)**



**Integrated
(INT)**



**Organic
(ORG)**

Tillage	No	Optimized	Reduced	Plough
N	High	Optimized	Reduced	No
Pesticides	High	Optimized	Reduced	No

Intensification gradient

Material and methods

Montevideo FSD 2019

Results: Some causal indicators relevant

Indicator	MACH	CONV	INT	ORG
Average N rate	Inconsistent	Inconsistent	intermediate	consistent
% cropped area with > 150 kg N/ha	Inconsistent	Inconsistent	consistent	consistent
Number of crops in the rotation	not concerned	not concerned	not concerned	not concerned
Diversity of crop families	intermediate	intermediate	intermediate	consistent
% of semi natural habitats in 1 km buffer	Inconsistent	intermediate	intermediate	consistent
Diversity of semi natural habitats in 1 km buffer	not concerned	not concerned	not concerned	not concerned



Inconsistent
 intermediate
 consistent
 not concerned

Results

DEXiPM V1 & V2 performing for fauna



Criterion	Indicator	Auximore DEXi	MASC 2.0	DEXiPM v1	DEXiPM v2
Global biodiversity			Inconsistent with gradient	Consistent with the gradient	
Flying insects	Flying insects		CONV = INT		
	Flying natural enemies	(MACH, CONV) and (INT, ORG).		Consistent with the gradient	
Soil fauna	Soil macro fauna		Only MACH is ≠		
	Soil natural enemies			Consistent with the gradient	
	Crawling natural enemies			Consistent with the gradient	

Inconsistent
 intermediate
 consistent
 not concerned

But for flora (weeds) DEXiPM V2 needs enhancement




Criterion	Indicator	Auximore DEXi	MASC 2.0	DEXiPM v1	DEXiPM v2
Flora	Weeds			Consistent with the gradient	Inconsistent with gradient
	Semi natural flora		Only ORG is >	Only ORG is >	Only ORG is >
Micro organisms	Soil micro organisms		Only ORG is >		

Inconsistent
 intermediate
 consistent
 not concerned

Discussion & conclusion

- ❖ Some causal indicators (N management) consistent with gradient data

 Easy to implement

 Low integration of processes

- ❖ DEXiPM V1 and V2 : able to provide consistent results with intensity gradient

- Exception for weeds: this indicator should be enhanced

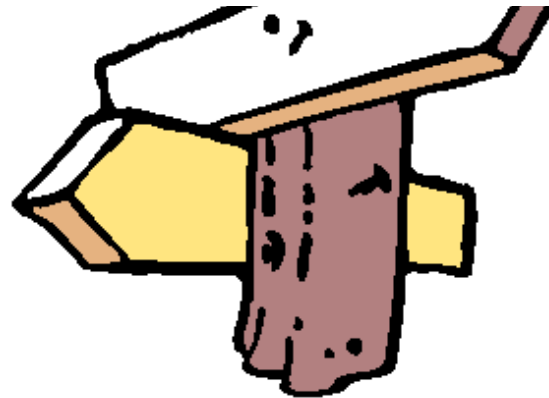
 *Ex ante* assessment: simulation

 Very qualitative

- ❖ Need to repeat such study
 - with datasets of several locations
 - taxon diversity/abundance measurements



Thank you for your attention



Acknowledgement: authors are thankful to the GIS “Grande Culture à Hautes Performances Economiques et Environnementales” (GC HP2E) for its support to the master thesis of Thomas Denoirjean